

U.S. Serial No. 10/786,108

520.43541X00

IN THE CLAIMS

BEST AVAILABLE COPY

1. (Currently amended) A computer system comprising a computer, a plurality of storage units each containing one or more volumes for storing data used by the computer, and a management computer for managing the status of the plurality of storage units, comprising:

one or more first-level storage units each containing one or more first volumes for storing data used by the computer, each of said first volumes being a target volume of an access sent from the computer via a fibre channel interface, and said one or more first volumes having at least one virtual volume,

one or more a plurality of second-level storage units, each of which is connected through a communication path fibre channel network to, and hierarchically linked to, one of the first-level storage units, said second-level storage units containing and contains one or more second volumes for storing data used by the computer, wherein as hierarchically linked, said one or more second level storage units have a volume that is available for use as a volume in one of said one or more first level storage units, wherein each of said second volumes can be a target volume of an access sent from the computer via a fibre channel interface.

U.S. Serial No. 10/786,108

520.43541X00

wherein said one or more first-level storage units are arranged to receive data access requests from said computer to said virtual volume, and to relay said data access requests to at least one of said second volumes based on a relationship between said virtual volume and said at least one second volume that corresponds to said virtual volume, such that said virtual volume as accessed by said computer is transparent as to its relationship to said at least one second volume,

volume information collecting means for collecting volume information on the total capacity of each of said first and second volumes contained in the first-level and the second-level storage units, respectively,

~~hierarchical virtualization~~ information collecting means for collecting virtualization information on the ~~hierarchical~~ relationships between said virtual volume volumes contained in the ~~first-level storage units~~ and said at least one second volume volumes contained in the ~~second level storage units~~, ~~said information on the hierarchical relationships identifying which volumes of said second level storage units and said first level storage units are hierarchically linked together,~~ and

effective capacity calculating means for calculating the total effective capacity of the volumes of the first-level and

U.S. Serial No. 10/786,108

520.43541X00

second-level storage units based on subtracting the capacity of the virtual volume from the total capacity of said first and second volumes by using the volume information and the hierarchical virtualization information thus collected.

2. (Currently amended) The computer system of claim 1, wherein the first-level storage units and the second-level storage units each contain one or more virtual storage areas as virtual volumes, and the management computer comprises the volume information collecting means, the hierarchical virtualization information collecting means, and the effective capacity calculating means.

3. (Currently amended) The computer system of claim 1, wherein each of the first-level storage units comprises means for storing the virtualization information on the hierarchical relationships between virtual volumes contained therein and volumes contained in the second-level storage units.

4. (Currently amended) The computer system of claim 1, wherein the volume information collected by the volume information collecting means includes at least an identifier and information on the capacity of each volume contained in

U.S. Serial No. 10/786,108

520.43541X00

the first-level and the second-level storage units, each said identifier being formatted according to an identifier format provided by said management computer.

5. (Currently amended) The computer system of claim 1, wherein the virtualization information collected by the hierarchical virtualization information collecting means includes information indicating the relationship between an identifier of each virtual volume contained in the first-level storage units and an identifier of its hierarchically-linked at least one second volume contained in the second-level storage units.

6. (Currently amended) The computer system of claim 1, wherein the management computer comprises a display for displaying the volume information collected by the volume information collecting means and the result of the calculation made by the effective capacity calculating means.

7. (Currently amended) The computer system of claim 1, wherein the management computer comprises a display that has a first display section for displaying the volume information of the at least one second volume volumes contained in the

U.S. Serial No. 10/786,108

520.43541X00

~~second-level storage units that are~~ that is hierarchically linked to the at least one virtual volume volumes contained in the first-level storage units, and a second display section for displaying the volume information of other volumes.

8. (Currently amended) The computer system of claim 1, further comprising an identifier management computer for managing the formats of identifiers of the volumes of the first-level and second-level storage units, wherein each of the first-level and the second-level storage units comprises means for inquiring the identifier format of the identifier management computer and means for composing the volume information and the ~~hierarchical~~ virtualization information in accordance with the identifier format held in the identifier management computer.

9. (Currently amended) A management computer for managing the status of storage units containing volumes for storing data used by a computer, comprising:

volume information collecting means for collecting volume information on the total capacity of first volumes from one or more first-level storage units containing said first volumes ~~for storing data used by the computer, each of said first~~

U.S. Serial No. 10/786,108

520.43541X00

volumes being a target volume of an access sent from the computer via a fibre channel interface, and said one or more first volumes having at least one virtual volume, and on the total capacity of second volumes from one or more second-level storage units, each of which is connected through a communication path fibre channel network to, and hierarchically linked to, one of the first-level storage units, said one or more second-level storage units containing and contains at least one second volume, for storing data used by the computer, wherein as hierarchically linked, said one or more second level storage units have a volume that is available for use as a volume in one of said one or more first level storage units, wherein each of said second volumes can be a target volume of an access sent from the computer via a fibre channel interface,

wherein said one or more first-level storage units are arranged to receive data access requests from said computer to said virtual volume contained in said one or more first-level storage units, and to relay said data access requests to said at least one second volume based on a relationship between said virtual volume and said at least one second volume that corresponds to said virtual volume, such that said at least

U.S. Serial No. 10/786,108

520.43541X00

one virtual volume as accessed by said computer is transparent as to its relationship to said at least one second volume,

hierarchical virtualization information collecting means for collecting virtualization information on the hierarchical relationships between said virtual volume volumes in the first level storage units and said at least one second volume volumes in the second level storage units, said information on the hierarchical relationships identifying which volumes of said second level storage units and first level storage units are hierarchically linked together; and

effective capacity calculating means for calculating the total effective capacity of the volumes of the first-level and second-level storage units based on subtracting the capacity of the virtual volume from the total capacity of said first and second volumes by using the volume information and the hierarchical virtualization information thus collected.

10. (Currently amended) The management computer of claim 9, further comprising a display for displaying the volume information collected by the volume information collecting means and the result of the calculation made by the effective capacity calculating means.

U.S. Serial No. 10/786,108

520.43541X00

11. (Currently amended) The management computer of claim 9, further comprising a display for displaying information on the virtual volume volumes in the ~~first level storage~~ that are made available to the computer, and an input device for inputting information on volumes, wherein information on volumes is displayed on the display as objects, and:

when a specific object on the display is selected by the input device, the corresponding second volume in the second-level storage unit located through the ~~hierarchical virtualization~~ information will be identified, and the corresponding volume information obtained by the volume information collecting means from the corresponding second volume will be displayed on the display.

12. (Currently amended) The management computer of claim 9, further comprising a display equipped with a screen having a first display section for displaying information on the at least one second volume that is volumes contained in ~~second level storage units~~ that are hierarchically linked to the virtual volume volumes contained in the ~~first level storage units~~, and a second display section for displaying information on other volumes.

U.S. Serial No. 10/786,108

520.43541X00

13. (Currently amended) The management computer of claim 9, further comprising a display for displaying as objects volume information of the first volumes in the first-level storage units collected by the volume information collecting means, wherein

a first object indicating that the virtual volume in said one or more [[a]] first-level storage units is actually provided by [[a]] one of said at least one second volume in [[a]] said one or more second-level storage units hierarchically linked thereto, and a second object representing the second volume in the second-level storage unit that is actually provided as the virtual volume in the first level storage unit hierarchically linked thereto, are displayed on the display in such a way as to reflect the hierarchical relationship between them.

14. (Currently amended) The management computer of claim 10, wherein on the display either a screen where information on said at least one second volume that is volumes in the second level storage units that are hierarchically linked to the virtual volume volumes in the first level storage units is hidden or a screen showing information on

U.S. Serial No. 10/786,108

520.43541X00

volumes in the second-level storage units that are not hierarchically linked to volumes in the first-level storage units is selectively displayed.

15. (Currently amended) A management method for managing, using a management computer, capacities of volumes storing data used by a computer, comprising the steps of:

providing [[a]] one or more first volumes in a first storage unit for storing data used by the computer, each of said first volumes being a target volume of an access sent from the computer via a fibre channel interface, and said one or more first volumes having at least one virtual volume,

establishing a hierarchical relationship between the first storage unit and a second storage unit that allows a volume one or more second volumes in said second storage unit to be made available for use as a volume in said first storage unit, a target volume of an access sent from the computer via a fibre channel interface, wherein said second storage unit is connected through a fibre channel network to, and hierarchically linked to, the first storage unit,

collecting from the first storage unit volume information on the total capacity of the first volumes contained therein,

U.S. Serial No. 10/786,108

520.43541X00

collecting from the second storage unit volume information on the total capacity of the second volumes contained therein,

wherein said first storage unit is arranged to receive data access requests from said computer to said virtual volume, and to relay said data access requests to at least one of said second volumes based on a relationship between said virtual volume and said at least one second volume that corresponds to said virtual volume, such that said virtual volume as accessed by said computer is transparent as to its relationship to said at least one second volume,

collecting virtualization information on the hierarchical relationships between the volumes contained in the first storage unit said virtual volume and the volumes contained in the second storage unit said at least one second volume, said information on the hierarchical relationships identifying which volumes of said second storage unit and said first storage unit are hierarchically linked together, and

calculating the total effective capacity of the volumes of the first and second storage units based on subtracting the capacity of the virtual volume from the total capacity of the first and second volumes by using the volume information on

U.S. Serial No. 10/786,108

520.43541X00

~~the of the first and second volumes and the virtualization information on the hierarchical relationships.~~

16. (Currently amended) The management method of claim 15, further comprising a step of displaying on a display the collected volume information on the first and second volumes and the calculated total effective capacity.

17. (Canceled).

18. (Currently amended) A storage medium on which is stored a program designed to run on a management computer for managing the storage capacities of storage units containing volumes for storing data used by a computer, the program when executed causing the management computer to perform a method comprising the steps of:

collecting from a first storage unit volume information on the total capacity of first volumes contained therein,

collecting from a second storage unit, having a hierarchical relationship with the first storage unit, volume information on the total capacity of second volumes contained therein, wherein said second storage unit is connected through a fibre channel network to, and hierarchically linked to, the

U.S. Serial No. 10/786,108

520.43541X00

first storage unit, and wherein said hierarchical relationship allows one or more second volumes in said second storage unit to be a target volume of an access sent from the computer via a fibre channel interface, wherein said second storage unit is connected through a fibre channel network to, and hierarchically linked to, the first storage unit,

collecting virtualization information on the hierarchical relationships between the volumes contained in the first storage unit and the volumes contained in the second storage unit, said information on the hierarchical relationships identifying which volumes of said second storage unit and said first storage unit are hierarchically linked together, wherein as hierarchically linked, said second storage unit has a volume that is available for use as a volume in said first storage unit said virtual volume and said at least one second volume, and

calculating the total effective capacity of the volumes of the first and second storage units based on subtracting the capacity of the virtual volume from the total capacity of the first and second volumes by using the volume information on the of the first and second volumes and the virtualization information on the hierarchical relationships thus collected,

U.S. Serial No. 10/786,108

520.43541X00

wherein said first storage unit is arranged to receive data access requests from said computer to said virtual volume, and to relay said data access requests to at least one of said second volumes based on a relationship between said virtual volume and said at least one second volume that corresponds to said virtual volume, such that said virtual volume as accessed by said computer is transparent as to its relationship to said at least one second volume.

19. (Currently amended) The ~~storage management computer~~ system of claim 1, further comprising an identifier management computer connected through the ~~communication path fibre channel network~~ to the one or more first-level storage units, the one or more second-level storage units, and the management computer, wherein the identifier management computer stores in a memory located therein, and manages, identifiers for identifying the volumes of the first-level and the second-level storage units in a standardized format, and upon receiving a request for identifier format information from one of the first-level or the second-level storage units or the management computer, retrieves the requested identifier format information from the memory, and sends the requested identifier format information to the first-level storage unit,

U.S. Serial No. 10/786,108

520.43541X00

the second-level storage unit, or the management computer requesting it.

20. (Currently amended) The management method of claim 15, further comprising

a step of registering in a memory, and managing, identifier format information for identifying volumes of the ~~first level storage units~~ first storage unit and the ~~second-level storage units~~ second storage unit in a standardized format, wherein

the management computer, when started up, retrieves the identifier format information from the memory, and, when collecting from the ~~first level and the second level~~ first and second storage units volume information on the volumes contained therein, and when collecting virtualization information on the ~~hierarchical~~ relationships therebetween, obtains the information thus collected based on the identifier format information.

21. (Currently amended) The management method of claim 20, wherein the identifier format information that is registered and managed includes at least the vendor name, the model name, and the volume number of the volume of the ~~first-~~

U.S. Serial No. 10/786,108

520.43541X00

~~level or the second level first or second storage unit, as the case may be so identified.~~

22. (Currently amended) The management method of claim 16, wherein ~~the a~~ screen of the display has a first display section for displaying the identifier, capacity, and associated icon of each volume of the first storage unit, and a second display section for displaying the identifier, capacity, and associated icon of each volume of the second storage unit, and a third display section for displaying the total available effective capacity.

23. (Currently amended) In a computer system including one or more first-level storage units each containing one or more first volumes for storing data used by a computer, one or more a plurality of second-level storage units each of which is connected through a communication path fibre channel network to, and hierarchically linked to, one of the first-level storage units, said second-level storage units containing and contains one or more second volumes for storing data used by the computer, and a management computer for managing the status of the volumes contained in the first-level and the second-level storage units, wherein as

U.S. Serial No. 10/786,108

520.43541X00

~~hierarchically linked, said one or more second-level storage units have a volume that is available for use as a volume in one of said one or more first-level storage units, a management method for managing the volumes contained in the first-level and the second-level storage units comprising:~~

~~providing one or more first volumes in the one or more first-level storage units for storing data used by the computer, each of said first volumes being a target volume of an access sent from the computer via a fibre channel interface, and said one or more first volumes having at least one virtual volume,~~

~~establishing a hierarchical relationship between one of the first-level storage units and one of the second-level storage units that allows a volume one or more second volumes in said one of the second-level storage units to be made available for use as a volume in said one of the first storage units, a target volume of an access sent from the computer via a fibre channel interface, wherein said one of the second-level storage units is connected through a fibre channel network to, and hierarchically linked to, one of the first-level storage units,~~

~~wherein said one of the first-level storage units is arranged to receive data access requests from said computer to~~

U.S. Serial No. 10/786,108

520.43541X00

said virtual volume, and to relay said data access requests to at least one of said second volumes based on a relationship between said virtual volume and said at least one second volume that corresponds to said virtual volume, such that said virtual volume as accessed by said computer is transparent as to its relationship to said at least one second volume,

storing in a memory, located in each of the first-level and the second-level storage units, identifier format information in a standardized format for identifying volumes of the first-level and the second-level storage units, respectively,

issuing a request for volume information from the management computer to the first-level and the second-level storage units, said volume information including volume information on the total capacity of the first volumes of the first-level storage units and volume information on the total capacity of second volumes of the second-level storage units,

consulting the identifier format information stored in the memory in each of the first-level and the second-level storage units upon receiving the request for volume information, and sending to the management computer the volume information including the number of volumes contained

U.S. Serial No. 10/786,108

520.43541X00

in it, their identifiers and their total capacities in the format specified in the identifier format information,

issuing a request for inter-volume hierarchical virtualization information from the management computer to the first-level and the second-level storage units, said hierarchical virtualization information identifying which volumes of said second-level storage units and said first-level storage units are hierarchically linked together,

consulting the identifier format information stored in the memory in each of the first-level and the storage-level second-level storage units, upon receiving the request for inter-volume hierarchical virtualization information, and sending to the management computer the inter-volume hierarchical virtualization information contained therein in the format specified in the identifier format information,

composing, based on the volume information and the inter-volume hierarchical virtualization information thus collected, a consolidated information table including an upper-volume column containing the identifier, capacity, icon number, and a flag indicating the existence of subordinate volumes for each volume belonging to the higher level of hierarchy[,]; and a lower-volume column containing the identifier, capacity, and

U.S. Serial No. 10/786,108

520.43541X00

icon number for each volume belonging to the lower level of hierarchy in the management computer,

registering the consolidated information table in a memory, and

displaying the contents of the consolidated information table retrieved from the memory in at least three display sections of the display: a first display section for displaying the identifiers, capacities, and associated icons of the volumes belonging to the higher level of hierarchy[[],]; a second display section for displaying the identifiers, capacities, and associated icons of the volumes belonging to the lower level of hierarchy[[],], and a third display section for displaying the total available capacity of the volumes of the first-level and second-level storage units based on subtracting the capacity of the virtual volume from the total capacity of the first and second volumes by using the volume information and the virtualization information.

24. (Currently amended) A management computer for managing the status of storage units containing volumes for storing data used by a computer, comprising:

a CPU and a fibre channel network interface ~~and~~ connected by a management network,

U.S. Serial No. 10/786,108

520.43541X00

wherein the CPU collects volume information on the volumes from one or more first-level storage units containing first volumes for storing data used by the computer and from one or more second-level storage units each of which is connected through a communication path fibre channel network to, and hierarchically linked to, one of the first-level storage units, each of said first volumes being a target volume of an access sent from the computer via a fibre channel interface, and said one or more first volumes having at least one virtual volume; said one or more second-level storage units containing and contains at least one second volume for storing data used by the computer, and collects virtualization information on the hierarchical relationships between volumes in the first level storage units and volumes in the second level storage units said virtual volume and said at least one second volume via said fibre channel network interface, wherein as hierarchically linked, said one or more second level storage units have a volume that is available for use as a volume in one of said one or more first level storage units, wherein each of said second volumes can be a target volume of an access sent from the computer via a fibre channel interface,

U.S. Serial No. 10/786,108

520.43541X00

wherein said one or more first-level storage units are arranged to receive data access requests from said computer to said virtual volume, and to relay said data access requests to at least one of said second volumes based on a relationship between said virtual volume and said at least one second volume that corresponds to said virtual volume, such that said virtual volume as accessed by said computer is transparent as to its relationship to said at least one second volume,

[[and]]

wherein said virtualization information on the hierarchical relationships identifies which volumes of said second-level storage units and said first-level storage units are hierarchically linked together[,], and

wherein said CPU calculates the total effective capacity of the volumes of the first-level and second-level storage units based on subtracting the capacity of the virtual volume from the total capacity of said first and second volumes by using the volume information and the hierarchical virtualization information thus collected.

25. (Currently amended) The management computer of claim 24, further comprising a display for displaying the volume information and virtualization information collected by

JAN-20-06 05:24PM FROM- MATTINGLY, STANGER, MALUR & BRUNDIDGE + 703 684 1157 T-678 P.027/038 F-365

U.S. Serial No. 10/786,108

520.43541X00

said CPU, and the result of the total effective capacity
calculation by said CPU.

**This Page is Inserted by IFW Indexing and Scanning
Operations and is not part of the Official Record**

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- BLACK BORDERS**
- IMAGE CUT OFF AT TOP, BOTTOM OR SIDES**
- FADED TEXT OR DRAWING**
- BLURRED OR ILLEGIBLE TEXT OR DRAWING**
- SKEWED/SLANTED IMAGES**
- COLOR OR BLACK AND WHITE PHOTOGRAPHS**
- GRAY SCALE DOCUMENTS**
- LINES OR MARKS ON ORIGINAL DOCUMENT**
- REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY**
- OTHER:** _____

IMAGES ARE BEST AVAILABLE COPY.

As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.